REMARKS/ARGUMENTS

Favorable reconsideration of this application, in light of the present amendments and following discussion, is respectfully requested.

Claims 1-7 and 9 are pending. By this amendment, Claim 1 has been amended; Claim 8 has been cancelled; and Claim 9 has been added. No new matter has been added.

The Office Action rejects Claims 1-8 under 35 U.S.C. 103(a) by US Patent No. 5,423,941 to Komura in view of US Patent No. 6,833,079 to Giordani and JP 03-196624A. This rejection is respectfully traversed.

The applied art does not teach or suggest a gas containing C and F is further added to the processing gas to prevent deposits from being accumulated at the openings of the patterned mask or to remove accumulated deposits at the openings of the patterned mask and wherein the patterned mask includes at least an oxide layer containing silicon, as claimed in Claim 1.

In contrast, Komura provides a method for performing an etching by using a gaseous mixture of HBr gas, SiF4 gas, SF6 gas, and O2 gas containing He gas as a processing gas in a sealed air tight processing chamber. Since HBr gas and/or SiF4 gas is included in the processing gas, a protective layer is formed on an inner sidewall of a hole. Please see the discussion of Komura in "Background of the Invention" of the application (see page 2, lines 1-23) as a prior art.

However, in Komura, the deposits (e.g., SiBrxOy, x and y being the combination ratios) are accumulated at the openings of the mask. Therefore, when an opening diameter of the mask becomes smaller than or equal to about 0.2 μm, the deposits accumulated at the openings of the mask may present a hampering effect on a fine patterning of the hole. Namely, the opening diameter becomes narrower; and, consequently, an apparent aspect ratio of the hole increases. An increase in the aspect ratio results in a decrement of an etching rate

and, further, a deterioration in the throughput. In addition, if the aspect ratio is greater than or equal to, e.g., 50, it becomes difficult to etch a bottom portion of the hole, so that the hole may not attain a designed depth.

Again, in accordance with exemplary embodiments of the present invention, since a gas containing C and F is further added, deposits at the openings of the mask are reduced or prevented from being accumulated or removed so that it is possible to vertically form fine deep holes or grooves of a high aspect ratio in a silicon layer with a high etching rate even in case a diameter of the opening of the mask is very small.

The Office Action acknowledges that Komura fails to teach or suggest adding a gas containing C and F to prevent deposits from being accumulated at the openings of the patterned mask or to remove accumulated deposits at the openings of the patterned mask. However, the Office Action asserts that Giordani (US 6,833,079) and JP 03-196624A disclose the features of the claimed invention and further asserts that the combination would render claim 1 obvious. Applicants respectfully disagree.

Applicants respectfully assert that there is no motivation to combine the teachings of Komura, Giordani and JP 03-196624A. In fact, Applicants respectfully assert that only the present application suggests the claimed combination of features. When an obviousness determination is based on multiple prior art references, there must be a showing by the patent examiner of some "teaching, suggestion, or reason" to combine the references. Gambro Lundia AB v. Baxter Healthcare Corp., 110 F.3d 1573, 1579, 42 USPQ2d 1378, 1383 (Fed. Cir. 1997) (also noting that the "absence of such a suggestion to combine is dispositive in an obviousness determination"). Whether motivation to combine the references is shown is a question of fact. See In re Dembiczak, 175 F.3d 994, 1000, 50 USPQ2d 1614, 1617 (Fed. Cir. 1999). Evidence of a suggestion, teaching, or motivation to combine prior art references may flow, *inter alia*, from the references themselves, the knowledge of one of ordinary skill

in the art, or from the nature of the problem to be solved. See Dembiczak, 175 F.3d at 999, 50 USPQ2d at 1617. Although a reference need not expressly teach that the disclosure contained therein should be combined with another, see Motorola, Inc. v. Interdigital Tech. Corp., 121 F.3d 1461, 1472, 43 USPQ2d 1481, 1489 (Fed. Cir. 1997), the showing of combinability, in whatever form, must nevertheless be "clear and particular." Dembiczak, 175 F.3d at 999, 50 USPQ2d at 1617. "Trade-offs often concern what is feasible, not what is, on balance, desirable. Motivation to combine requires the latter." Winner International Royalty Corp. v. Wang, 53 USPQ2d 1580, 1587 (Fed. Cir. 2000). Interpreting the Supreme Court's decision in Dickinson v. Zurko, 50 USPQ2d 1930 (1999) regarding the standard of review in patent matters, the CAFC determined that when upholding a rejection of a claimed invention in an appeal, the CAFC must find that the decision by the USPTO Board of Appeals and Interferences is supported by "substantial evidence," In re Gartside, 53 USPQ2d 1769 (Fed. Cir. 2000). Accordingly, for a proper rejection based on a combination of references, the rejection must be supported by evidence that the motivation to combine references was not merely feasible, but desirable. The rejection of the claims under 35 U.S.C. §103(a) is respectfully traversed on the grounds that a prima facie case of obviousness of the claims has not been established.

Giordani discloses a method of etching a shaped cavity in a substrate, where the width of the shaped cavity is equal to or greater than the depth of the shaped cavity by controlling the process chamber pressure during the performance of the etching process. For example, the shaped cavity has a round, horizontal elliptical shape or buried cavity. Further, Giordani only teaches that CF_4 may be used to replace SF_6 or may be added to SF_6 in order to obtain a desired effect.

The Office Action asserts that it would have been obvious to one of ordinary skill in the art to add a gas comprising C and F to the plasma of Komura because Giordani teaches

that to do so is useful to achieve a desired profile in the substrate. However, in accordance with Giordani, the desired effect means a desired lateral etch without an undesired deeper vertical etch. (See column 1, lines 52-64) while the desired effect is to vertically form a deep hole with a small opening diameter by eliminating deposits at the openings of the mask. Furthermore, the object of Giordani is to provide a method of etching a shaped cavity in a substrate by avoiding the buildup of etch byproducts on interior surfaces of the shaped cavity during the etching process resulting in the desired amount of lateral etching without deepening of the cavity.

On the contrary, an object of exemplary embodiments of the present invention is to prevent deposits (e.g., SiBrxOy, x and y being combination ratios) from being accumulated at the openings of the patterned mask or to remove accumulated deposits at the openings of the patterned mask to vertically and highly precisely form a deep hole having an very small opening diameter.

Additionally, Giordani relates to anisotropic and isotropic etching while exemplary embodiments of the present invention relate to anisotropic etching; and primary etchant gas combinations preferred to etch a shaped cavity in Giordani are different from those of exemplary embodiments of the present invention. Giordani discloses that CF_4 may be used to replace SF_6, while the gas containing C and F is added to the processing gas containing SF_6 in accordance with the present embodiments of the invention. Accordingly, although CF_4 may be used to replace SF_6 in Giordani, the disclosures of Giordani are different from the features recited in amended claim 1.

Consequently, neither Komura nor Giordani teaches or even suggests a method of forming fine deep holes or grooves of a high aspect ratio in a silicon layer with a high etching rate even in case a diameter of the opening of the mask is very small, unlike embodiments of

the present invention. Thus, it is respectfully submitted that there is no basis in the teachings of either of Komura or Giordani to support the applied combination.

Meanwhile, JP 03-196624A discloses a method for forming trenches with high anisotropy and same depth regardless of the magnitude of a pattern width. In accordance with JP 03-196624A, conventionally, when a plurality of trenches are formed at the same time, trenches having a wide opening width have a tapered profile due to an excessively formed sidewall protective film; and bowing effect is caused in trenches having a narrow opening width. To solve these problems, JP 03-196624A suggests a method of removing a portion of the excessively formed sidewall protective film (See the upper left paragraph in page 4) in the trenches having a wide width by using a gas containing C, F and HBr. Further, specifically, resist material is used as an etching mask 12; and reaction products between HBr and the resist material are attached to the sidewall of trench to form a sidewall protective film which is organic-based sidewall material (See the upper right paragraph in page 4).

In contrast, in accordance with embodiments of the present invention, the patterned mask includes at least an oxide layer containing silicon; and a protective layer on inner walls of the holes is formed by HBr gas or SiF_4 gas; and, further, the protective layer is not removed. Instead, accumulated deposits (e.g., SiBrxOy, x and y being combination ratios) at the openings of the patterned mask are removed or deposits are prevented from being accumulated at the openings of the patterned mask to remove a hampering effect on a fine patterning of the hole.

Consequently, JP 03-196624A teaches away from the claimed invention as recited in amended claim 1. That is, JP 03-196624A does not disclose nor suggest an etching method of forming fine deep holes or grooves of a high aspect ratio in a silicon layer with a high etching rate even in case a diameter of the opening of the mask is very small by preventing deposits from being accumulated at the openings of the patterned mask or removing accumulated

deposits at the openings of the patterned mask and wherein the patterned mask includes at least an oxide layer containing silicon.

Accordingly, it is respectfully submitted that there is no basis in the teachings of either of Komura, Giordani, or JP 03-196624A to support the applied combination. Certainly, the outstanding Office Action fails to cite to any specific teachings within any of these references to provide motivation for the combination. Accordingly, it is respectfully submitted that the combination of Komura, Giordani, and JP 03-196624A is the result of hindsight reconstruction in view of the present specification, and is improper.

Claims 2-7 and newly added claim 9 are allowable for at least the reasons discussed above with respect to the amended claim 1 as well as for the additional features recited therein. Accordingly, it is respectfully requested that the Examiner's rejections be withdrawn and that claims 1-7 and 9 be allowed.

Consequently, in view of the foregoing discussion and present amendments, it is respectfully submitted that this application is in condition for allowance. An early and favorable action is therefore respectfully requested.

Respectfully submitted,

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